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**Remediation of Acid Mine Drainage
After Thought Mine
Redding, CA**

by

**H.P.T. Research, Inc.
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Federal ID#
68-0389789

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Project Group
Other Services

**ACID MINE REMEDIATION
FOR
THE AFTER THOUGHT MINE
REDDING, CA
By
H.P.T. Research, Inc.**

This proposal represents H.P.T. Research, Inc. technology to remediate acid mine drainage. H.P.T. has successfully performed bench scale tests for the removal of heavy metals from Acid Mine Drainage.

H.P.T. will design, construct and operate a pilot treatment system with 5-15+ gallons per minute treatment. The process will remove heavy metals to below maximum contaminant levels for drinking water standards. The project will demonstrate a new treatment process for heavy metal laden water that is presently entering the Sacramento River and Bay-Delta Region. The reduction of heavy metals in this region will improve the water quality. CALFED has identified water quality in the Sacramento River and Bay-Delta Region as a primary stressor on fish, wildlife and humans.

The project will cost \$ 787,500 for H.P.T. Research, Inc. to design, construct and operate the system for 1 year.

H.P.T. has successfully been conducting research and development in water treatment processes for more than 5 years. H.P.T. has successfully performed bench tests removing heavy metal from Acid Mine Drainage water from Iron Mountain Mine, Redding, CA, and the Berkeley Pit, Butte MT. Third party validation of the treatment system was done by California State University, Fresno.

The project will be continuously monitored and tested by H.P.T. and B.S.K. Laboratories. Data evaluation will be performed by H.P.T. and B.S.K. Laboratories and State agencies.

This project will identify a new technology for a water quality problem that has been identified for many years. The treatment system will demonstrate a remediation process that is more effective and with less impact on the environment than present treatment systems.

CALFED has identified Acid Mine Drainage as a primary stressor on water quality in the Sacramento River and Bay-Delta Region.

H.P.T. Research, Inc. proposes to design, construct and operate a pilot test treatment system at the After Thought Mine.

The After Thought Mine is located in Shasta County, 24 miles Northeast of Redding, CA on Highway 299. The mine is presently discharging heavy metal laden acidic water at 20+ gallons per minute. The discharge is flowing into Cow Creek, a Sacramento River Tributary. Cow Creek is a winter and spring spawning area for Steelhead and Salmon. The primary contaminants are Copper, 1.9mg/l; Zinc, 110mg/l; Cadmium, 0.56mg/l and a Ph of 2.8. The mine is one of many sources of heavy metal in the Sacramento River and the Bay-Delta region. The After Thought mine is currently under a cease and desist order for mine contaminated discharge. H.P.T. has successfully demonstrated bench scale water remediation, by reducing the heavy metal contamination to below 60ug/l and reduction of Sulfate levels to below 2000mg/l. These tests have been conducted as third party validation tests performed by California State University, Fresno (see attached letter), Lawrence Livermore National Laboratory and Montana Tech of the University of Montana.

H.P.T. will design and construct a pilot treatment system that will reduce the heavy metal contaminants to below Maximum Contaminant levels; the process will reduce Sulfate levels to below 2000 mg/l. H.P.T. will operate the treatment system for 1 year. HPT expects the design and construction will take 2 months. The initialization and adjustments to the system will take 1-2 weeks. This treatment system will demonstrate a continuous flow process that will reduce the heavy metal contaminants, the sulfate levels and produce water that will be dischargeable to Cow Creek, at a demonstrated economical scale.

Present treatment systems in the Sacramento River Basin utilize technology that have made few advances in the past 30 years. Most systems are utilizing lime treatment which does not reduce all the heavy metal contaminants. The present treatment systems produce water that still contain heavy metals, also high levels of sulfate and produce tons of sludge; that has to be treated as a hazardous waste. The H.P.T. treatment system produces a metal hydroxide cake that is insoluble and may be recycled. The treatment system also produces an anhydrous calcium sulfate cake. This reduces the sulfate levels, for better water quality. Fish and Game has identified high sulfate level as a stressor for fish and habitat.

The heavy metal contamination of the Sacramento River basin has been documented over a long period of time. CALFED has identified mine discharge as a stressor in the subcategory of Water Quality. The contaminants, even in sub-lethal concentration have detrimental effects on some aquatic species, including reduced rates of growth, interference with physiological processes necessary for successful migration, and inhibition of gill function. Accumulation of copper and cadmium in the tissue of the fish, also has

the same effects. There have been periodic fish kills. Heavy metal contamination has caused the elimination of aquatic life and all other beneficial use of some of the water courses.

The successful demonstration of the H.P.T. treatment system will provide a viable means to reduce heavy metal contamination of the Sacramento river and Bay-Delta region.

The project will proceed in phases:

Phase 1 will be the design and construction phase. H.P.T. will design and construct a pilot treatment system, with a flow rate of 5-15+ gallons per minute. H.P.T. anticipates that this phase will take 2 months. Monthly reports will be submitted detailing the progress.

Phase 2 will be the initialization and start-up phase. H.P.T. anticipates this will take 1 month. The system will run a minimum of 8 hours a day, with tests of system discharge every 2 hours for the month. At the end of the this phase of operation, a report will be submitted detailing the system operation and lab testing results.

Phase 3 will be system operation for 11 months. H.P.T. will submit reports on the operation and maintenance and lab tests results. See the section on monitoring for test frequency.

PHASE 1

Labor	\$ 40,000
Overhead	20,000
Materials & Acquisition	151,000
Misc.	<u>10,000</u>
Total Cost Phase 1	<u>\$221,000</u>

PHASE 2

Labor	\$ 30,000
Overhead	15,000
Service Contracts (testing & equipment rentals)	12,000
Materials & Acquisition	14,000
Misc.	<u>9,000</u>
Total Cost Phase 2	\$ 80,000

PHASE 3

Labor	\$155,000
Overhead	77,000
Service Contracts (testing & equipment rentals)	38,000
Material & Acquisition	168,000
Misc.	<u>48,000</u>

Total Cost Phase 3	\$486,500
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Total Project Cost	<u>\$787,500</u>
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H.P.T. proposes to monitor the treatment system by pulling grab samples as follows:

Month 1

Raw samples at system start-up (daily)
Treated samples every 2 hours of operation

Month 2 and 3

Raw sample at system start-up (daily)
Treated sample at noon and end of day

Month 4

Raw sample at system start-up (daily)
Treated sample at end of day

Month 5

Raw sample at system start-up (M,W,F)
Treated sample at end of day (M,W,F)

Month 6

Raw sample at system start-up (T,F)
Treated sample at end of day (T,F)

Month 7 thru 12

Raw sample at system start-up (W)
Treated sample at end of day (W)

The outside laboratory testing will be performed by BSK Analytical Laboratories. H.P.T. will draft a Q.A.P.P. as part of the project. The Q.A.P.P. will incorporate the Q.A.P.P. of BSK Laboratories. The project will demonstrate a new way to treat acidic heavy metal discharge. The test results will be available for review by any interested party.

H.P.T. anticipates that the project will be in compliance with all laws and regulations. The project takes a hazardous discharge and produces non-hazardous by-products and dischargable water. The owner of the After Thought mine has given H.P.T. permission to conduct this project. H.P.T. believes that upon the successful completion of this project and publishing of the results, considerable support will be shown for treatment program for the Sacramento river and Bay-Delta Region.

H.P.T. Research, Inc. has been successful in doing research and development for water treatment systems for more than 5 years. H.P.T. has successfully performed bench tests for acid mine treatment for EPA at Montana Tech, University of Montana. H.P.T. has performed third party testing for California State University, Fresno.

H.P.T. is a private corporation. H.P.T. will have the following personnel involved in the project.

J. Michael Overton, Senior Scientific Investigator:

Mike attended California State University, Chico with a major in Industrial Arts. This was followed with certificates in Industrial Machining , a Secondary Teaching Credential, Gunsmithing and teaching over 10 years at the college level, Mike has successfully owned and operated an industrial machine company specializing in helicopter parts and tools, underground boring equipment and prototype manufacturing for the farming, food service and construction industries.

His early interest in magnetics and his initial research regarding magnetic field influence on various types of fluids lead to the development of an unique single pole magnet. Mike has steadfastly pursued H.P.T. research and development during the past 10 years with 3 US Patents, 11 Patents Pending and numerous other applications to be filed shortly.

S.R. Wurzbarger, Senior Scientific Investigator:

Following college with a degree in General Education and Earth Sciences, Steve served 2 tours of duty in Vietnam in the communications and electronics fields. He then attended college with degrees in Electronics and Law Enforcement. For several years he was employed in the thermal energy and natural gas production industries for a major California public utility.

For the past 20 years he has been closely associated with the Western mining industry working in a variety of positions including underground mining, Placer

mining, geological surveying and design and construction of mineral recovery systems.

Steve has pursued H.P.T. research and development for the past 10 years with 3 US Patents, 11 Patents Pending and numerous other applications to be filed shortly.

David C. Triplett, Jr., Administration

David is a Vietnam veteran with more than 5 years of college. David has been involved with the environmental field for more than 25 years. He has been doing environmental compliance and entitlement throughout California.

For the past 20 years, David has served as an executive and owner for companies developing more than 25,000 units of residential housing units and more than 1000 acres of commercial or industrial development. David was the executive in charge of directing the environmental planning, compliance, development and construction.

Tim Hoel, ClearWater Systems:

Tim has over 30 years experience in the chemical specialty industry. Following college he immediately started selling industrial chemical specialty products. He has held positions in sales, marketing, management, chemical formulation and manufacturing and has successfully owned and operated his own business.

Since 1985 he has been primarily involved in the manufacturing and sales of chemical and mechanical equipment to the industrial wastewater treatment industry. With a knowledge of chemical precipitation chemistry utilizing polymer flocculation of waste stream contaminants, Tim designed a unique Clarification, Recycling and Sludge Management System (ClearWater Systems) for the small to medium industrial waste stream generator. ClearWater Systems, a division of H.P.T. Research, Inc. currently manufactures in Rancho Cordova, CA.

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March 12, 1997

Mr. J. Michael Overton, President
HPT Research, Inc.
10536 Brunswick Road
Grass Valley, CA 95945

Re: Evaluation of HPT Acid Mine Drainage Treatment Process

Dear Mike:

Thank you for your comments of 1/23/97 faxed to Dr. Gump concerning the cover letter and report subject above. We have reviewed the report taking your comments into consideration, and the revised report dated March 12, 1997 is enclosed with this letter.

The revised report does not appreciably change our conclusions regarding HPT Research, Inc.'s AMD Treatment Process which are restated as follows:

- * The influent sample AMD provided to us contained high concentrations of iron (19,000 mg/L), copper (182 mg/L), cadmium (16.5 mg/L) and zinc (2,050 mg/L)
- * The heavy metal content of the process effluent was determined to be below our analytical detection limits of 1.2 mg/L, 1.7 mg/L, 0.5 mg/L, and 0.6 mg/L for iron, copper, cadmium, and zinc respectively.
- * The process effluent was an alkaline solution (pH 13) characterized by high concentrations of potassium (20,000 mg/L), chloride (6,370 mg/L), and sulfate ions (11,400 mg/L). The high chloride content is likely due to chloride contamination in the $\text{Ca}(\text{OH})_2$.
- * The heavy metals from the AMD sample (iron, copper, cadmium, and zinc) were deposited in the "metals" product cake with recoveries of approximately 100 percent.

Based on the above results, we believe that this bench-level, batch AMD treatment process can produce a product water with significantly reduced heavy metal content. This process should definitely be evaluated at a continuous flow, prototype level.

Sincerely,

A handwritten signature in black ink, appearing to read "Barry H. Gump".

Barry H. Gump, Ph.D.
Co-Principal Investigator

A handwritten signature in black ink, appearing to read "Karl E. Longley".

Karl E. Longley, Sc.D., P.E.
Co-Principal Investigator

Encl. (1)

THE CALIFORNIA STATE UNIVERSITY

NONDISCRIMINATION COMPLIANCE STATEMENT

COMPANY NAME

HPT RESEARCH, INC.

The company named above (hereinafter referred to as "prospective contractor") hereby certifies, unless specifically exempted, compliance with Government Code Section 12990 (a-f) and California Code of Regulations, Title 2, Division 4, Chapter 5 in matters relating to reporting requirements and the development, implementation and maintenance of a Nondiscrimination Program. Prospective contractor agrees not to unlawfully discriminate, harass or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, disability (including HIV and AIDS), medical condition (cancer), age, marital status, denial of family and medical care leave and denial of pregnancy disability leave.

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized to legally bind the prospective contractor to the above described certification. I am fully aware that this certification, executed on the date and in the county below, is made under penalty of perjury under the laws of the State of California.

OFFICIAL'S NAME

DAVID C TRIPLETT, JR

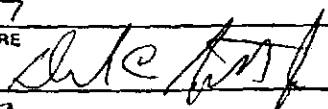
DATE EXECUTED

7-28-97

EXECUTED IN THE COUNTY OF

NEVADA

PROSPECTIVE CONTRACTOR'S SIGNATURE



PROSPECTIVE CONTRACTOR'S TITLE

CORP SEC

PROSPECTIVE CONTRACTOR'S LEGAL BUSINESS NAME

HPT RESEARCH, INC.